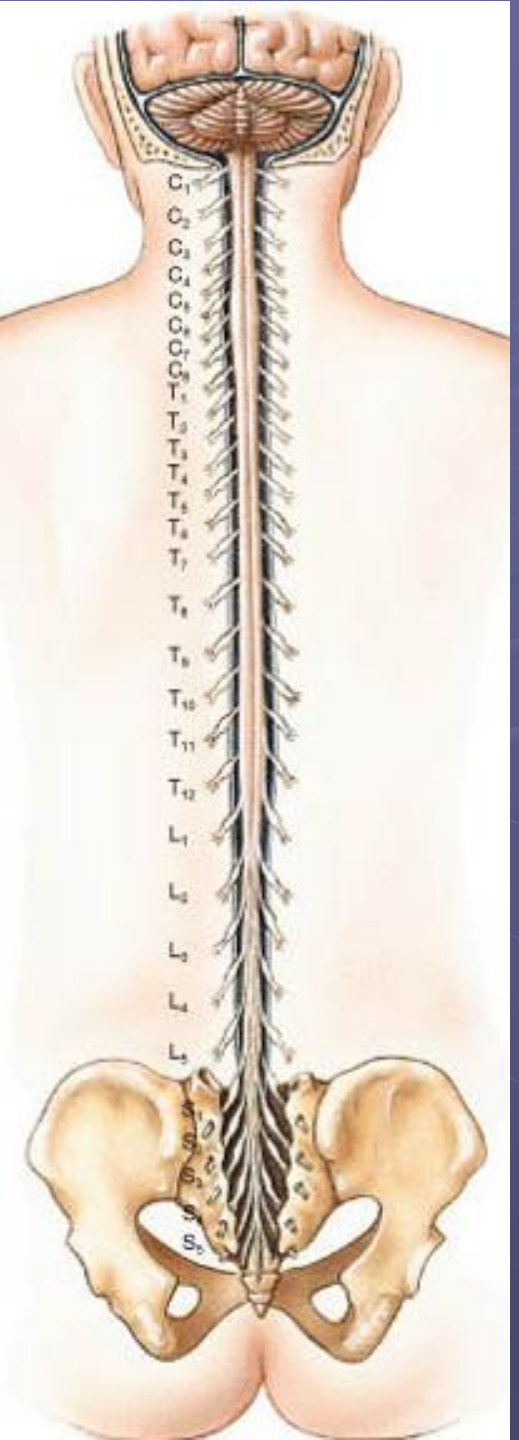


Ch 13: Central Nervous System: Part 2

1. Meninges
2. CSF
3. Spinal Cord and Spinal Nerves

Explain spinal cord anatomy, including gray and white matter and meninges (give the general functions of this organ).

Discuss the structure and functions of the spinal nerves and plexuses.

Describe the structural components of reflexes.

Developed by
John Gallagher, MS, DVM

LAS POSITAS COLLEGE

1. Cranial Meninges

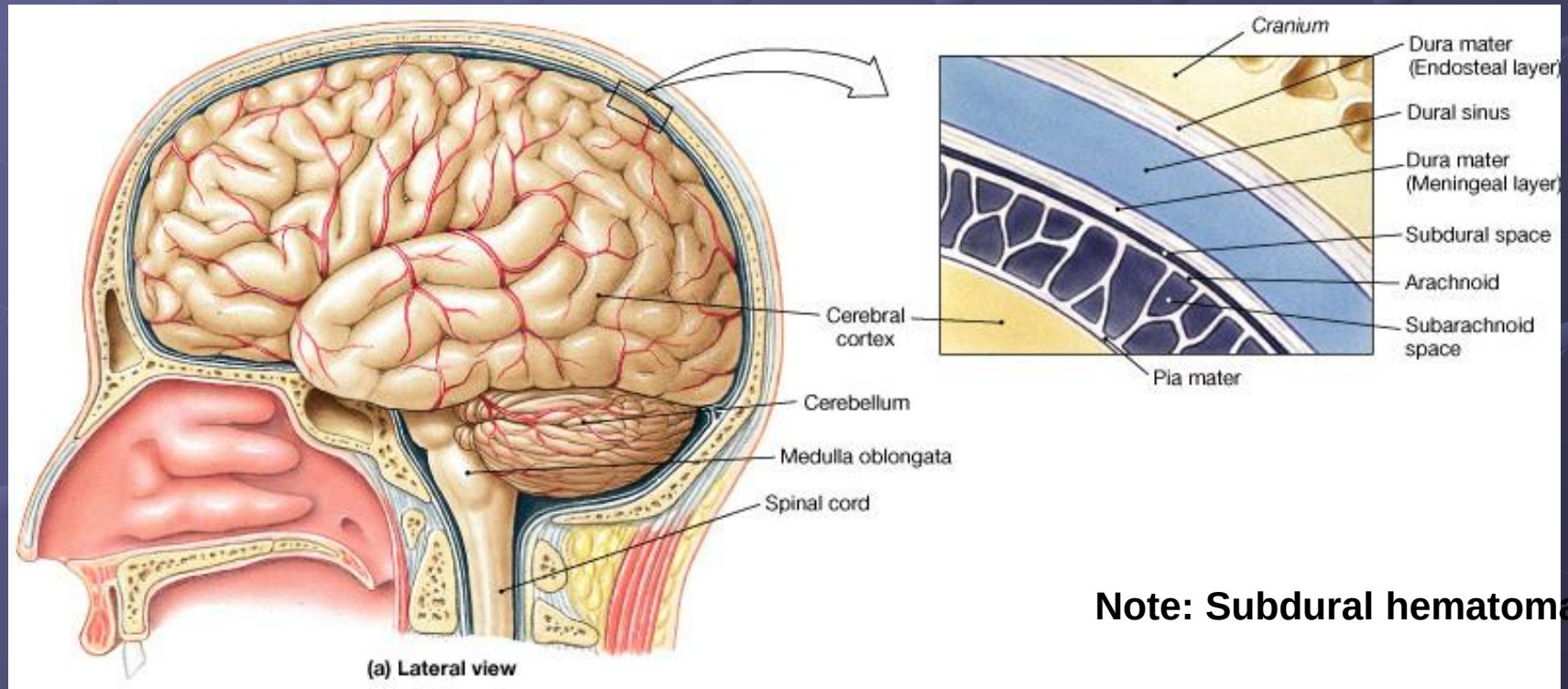
Three layers:

1. Dura mater - strong, "tough mother"

- **a. falx cerebri**
- **b. falx cerebelli**
- **c. tentorium cerebelli**

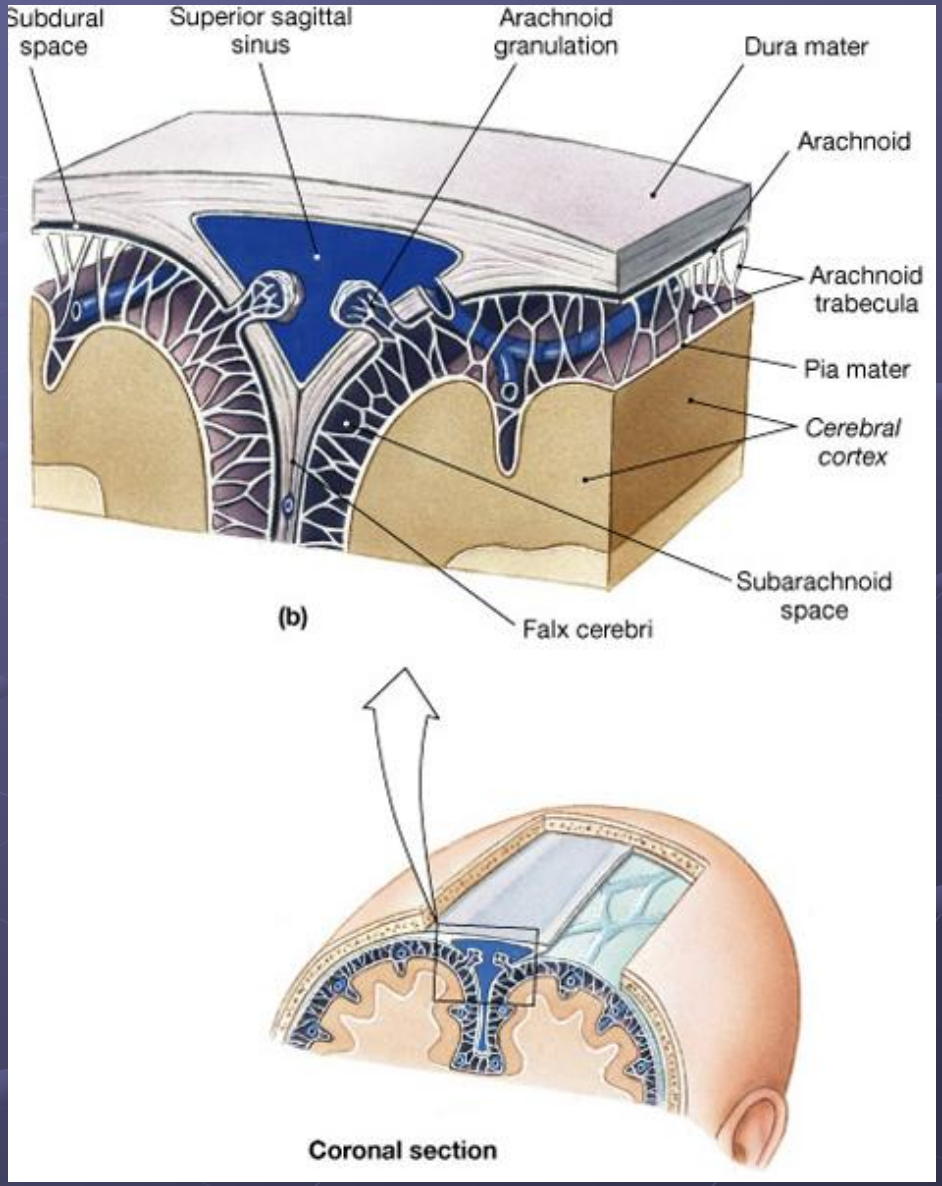
2. Arachnoid - spidery, holds blood vessels

3. Pia mater - "delicate mother"



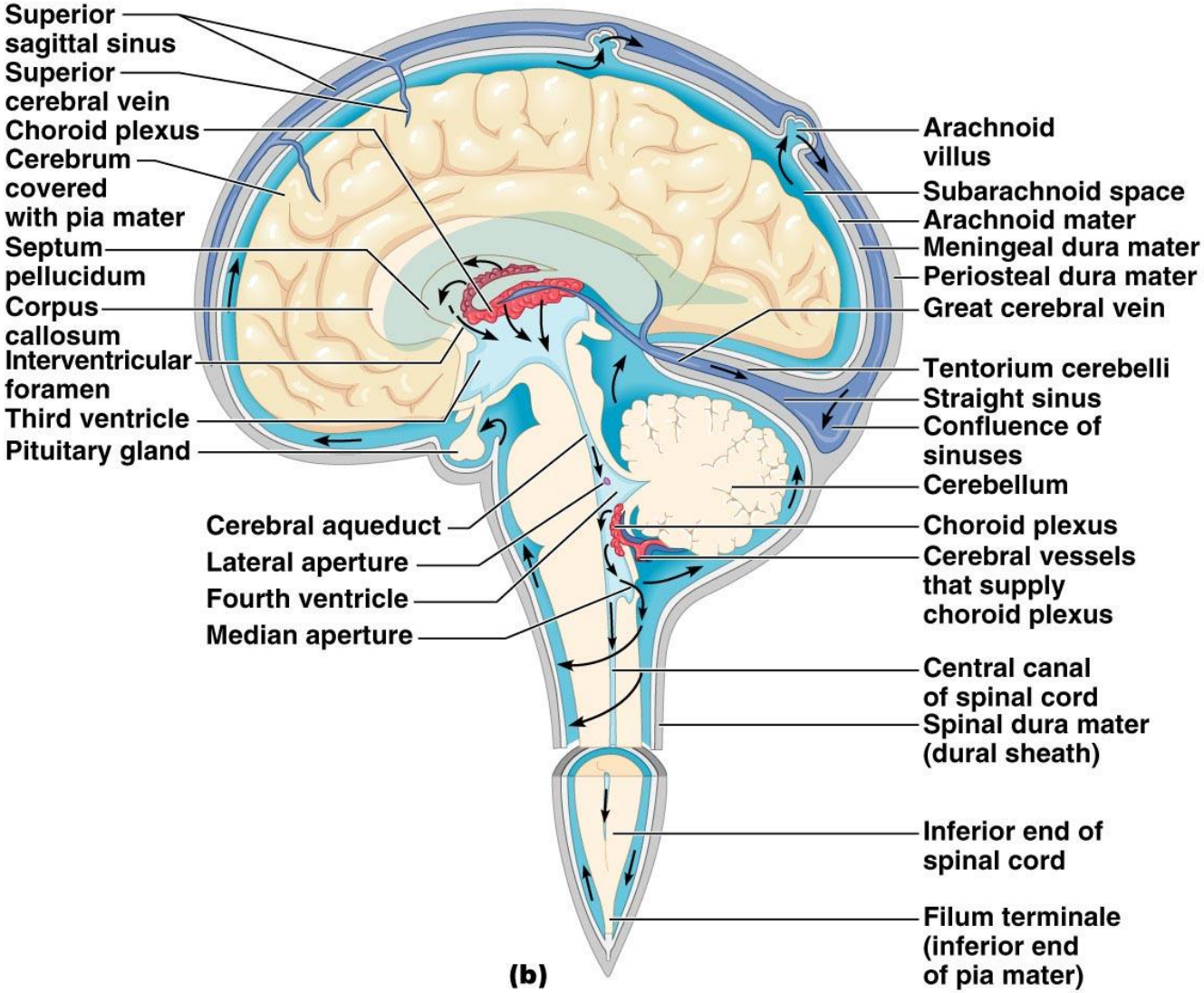
Note: Subdural hematoma

The meninges



2. CSF: Cerebrospinal Fluid

- **Formation in ventricles by specialized ependymal cells of choroid plexus** (~500 mL/day; total volume ~ 150 mL)
- ***Functions***
  - **transport medium (nutrients, waste)**
  - **shock absorption**
  - **buoyancy (floats the brain)**
- **CSF circulation: Ventricles → central canal → subarachnoid space**
- **An important diagnostic tool.**



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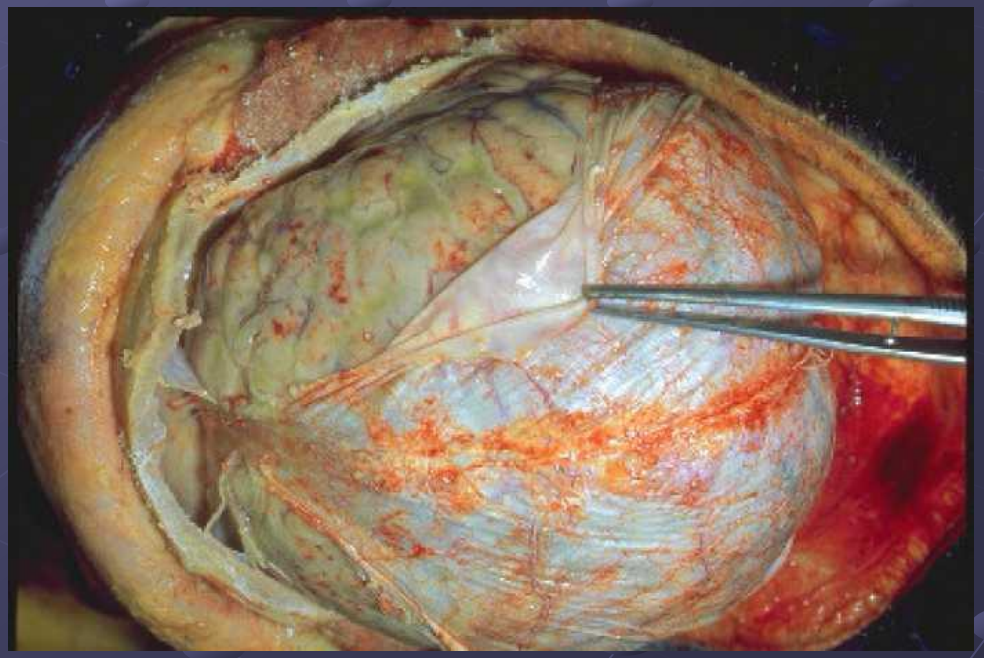
Hydrocephalus?

Arachnoid granulations: This is where the CSF produced in the choroid plexuses of the ventricles and which has circulated into the subarachnoid space is reabsorbed.

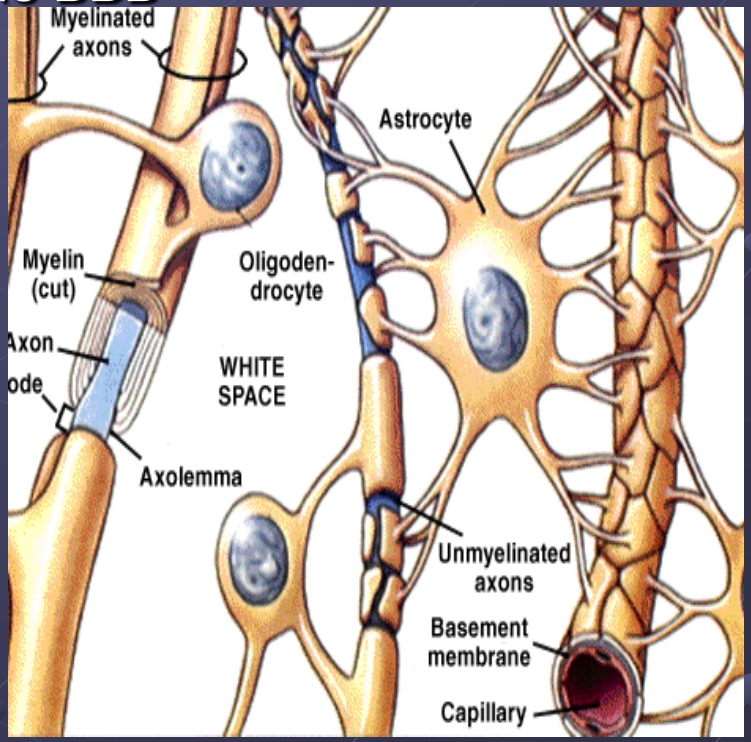
Meningitis: inflammation of meninges/CSF

- Bacterial
  - Relatively rare
  - Life threatening
  - Antibiotics
- Fungal
- Viral—most common
  - Younger
  - Self-resolving



Blood Brain Barrier (BBB)

- Tight Junctions in capillary endothelium prevent passive diffusion into the brain. Lots of Active Transport, especially of H_2O soluble compounds (think glucose).
- Fat soluble compounds readily pass the BBB
  - E.g. steroid hormones, ADEK
- Major role of astrocytes
- *3 areas in brain don't have BBB*
  - portion of hypothalamus
  - pineal gland (in diencephalon)
  - choroid plexus



3. Spinal cord:

- Resides inside <u>vertebral canal</u>
  - Extends to L1/ L2
- 31 segments, each associated with a pair of dorsal root ganglia
- Two enlargements
  - Cervical and Lumbar
- Conus medullaris
- Cauda Equina
- Filum Terminale
  - Continuation of pia mater beyond the end of the spinal cord

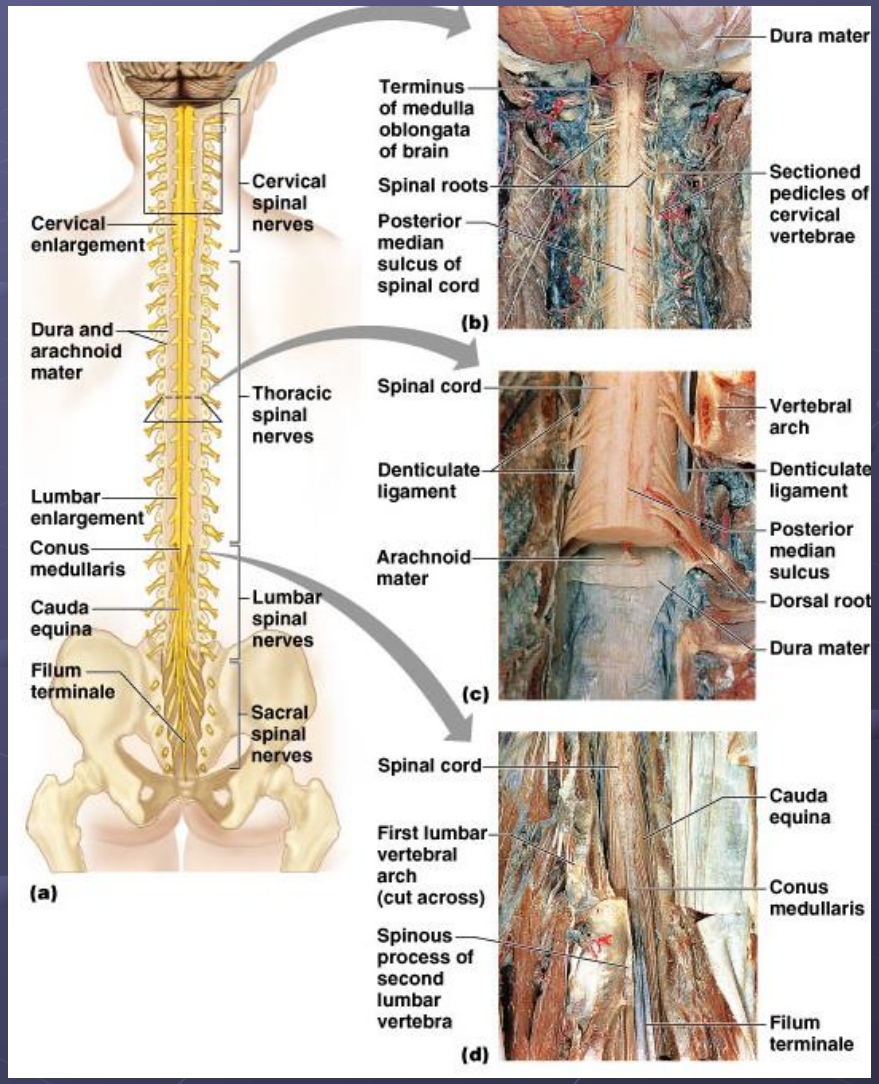
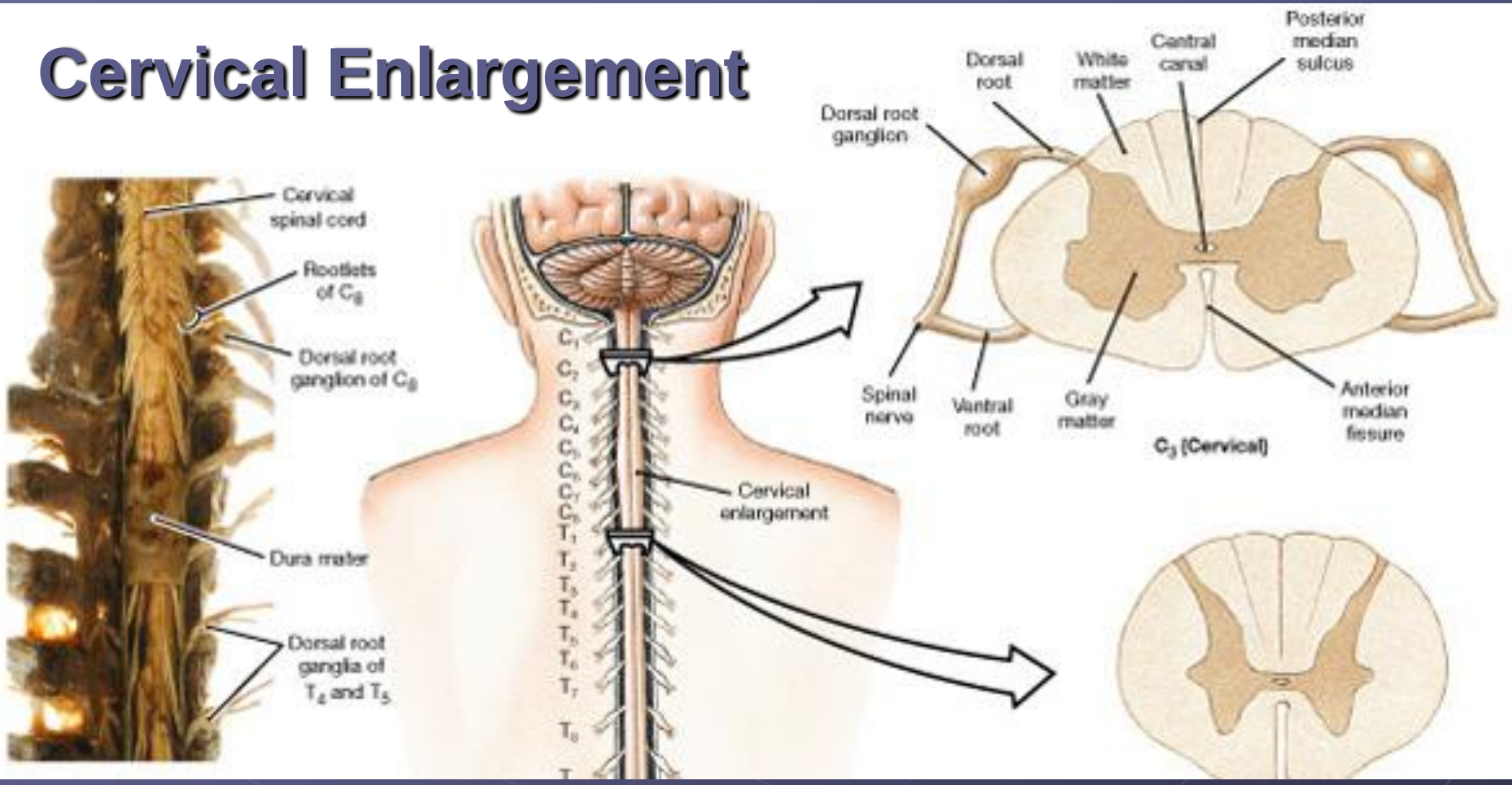


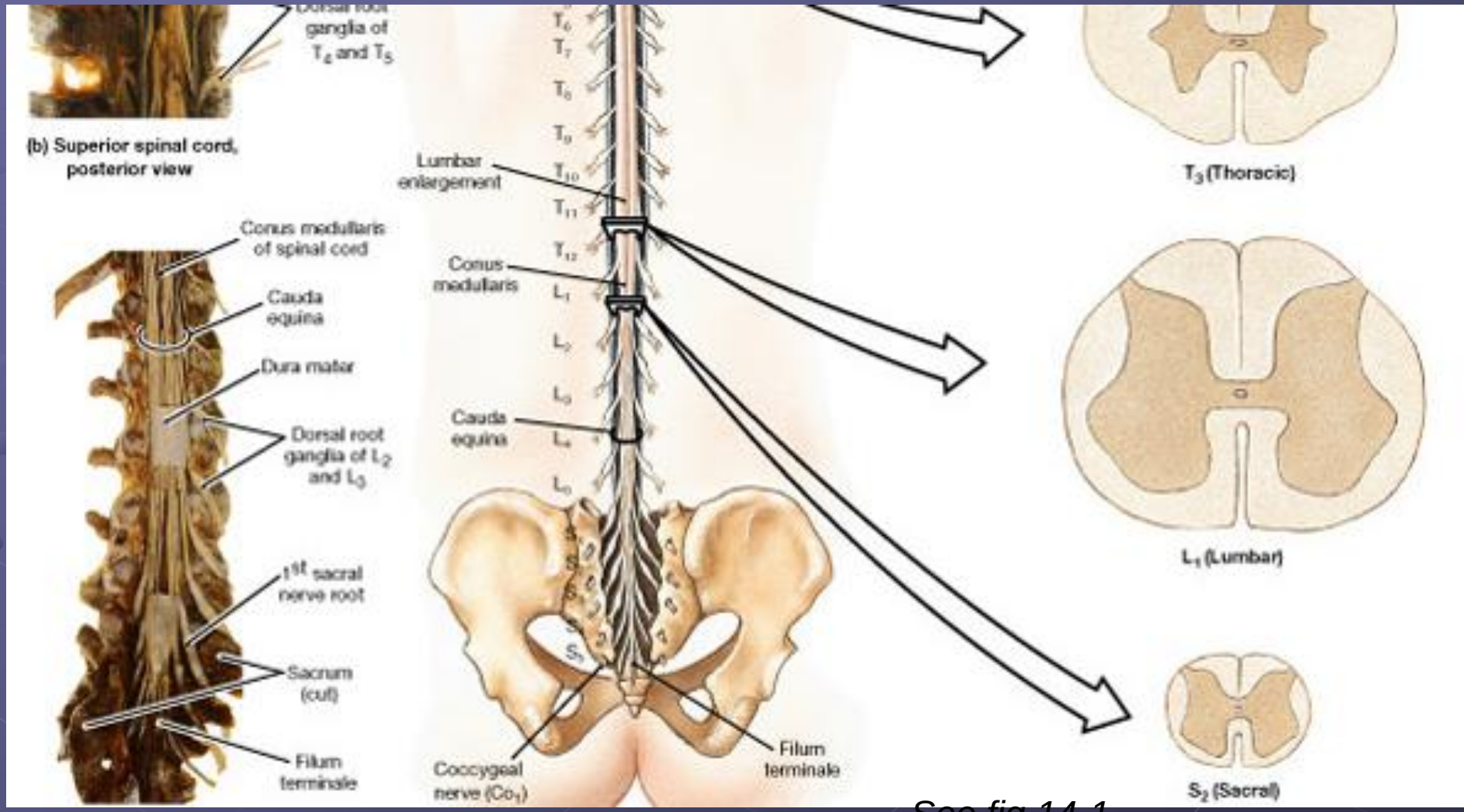
Fig. 13-29

Cervical Enlargement



Gray matter expanded to incorporate more sensory input from limbs and more cell bodies for motor control of limbs

Lumbar Enlargement



See fig 14-1

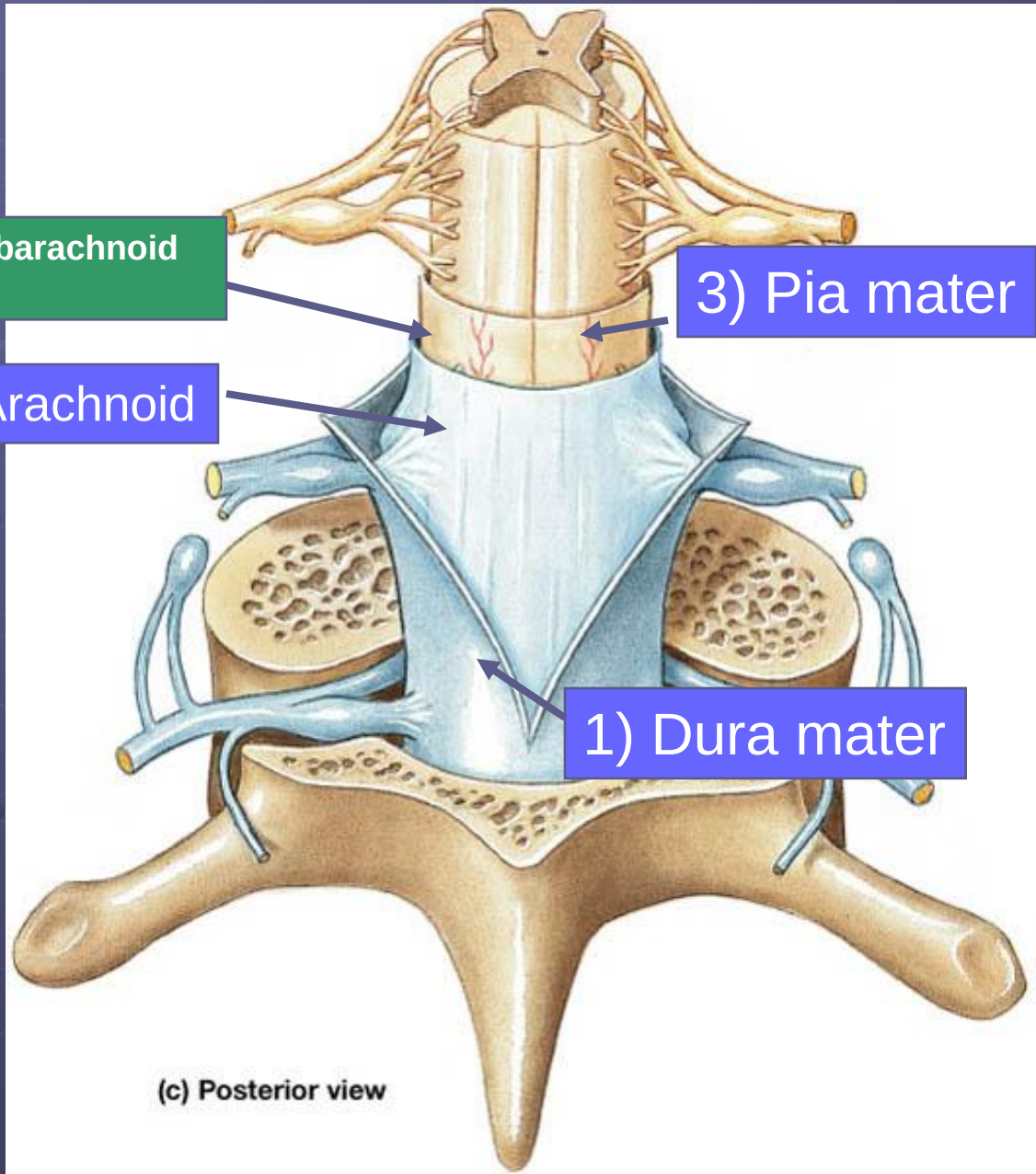
Spinal Meninges

Three membranes surround all of CNS

1) Dura mater - "tough mother", strong. Note the Epidural Space.

2) Arachnoid - spidery looking, carries blood vessels, etc. Note the Subarachnoid space which contains CSF

3) Pia mater - "delicate mother", adheres tightly to surface of spinal cord



Transverse Section

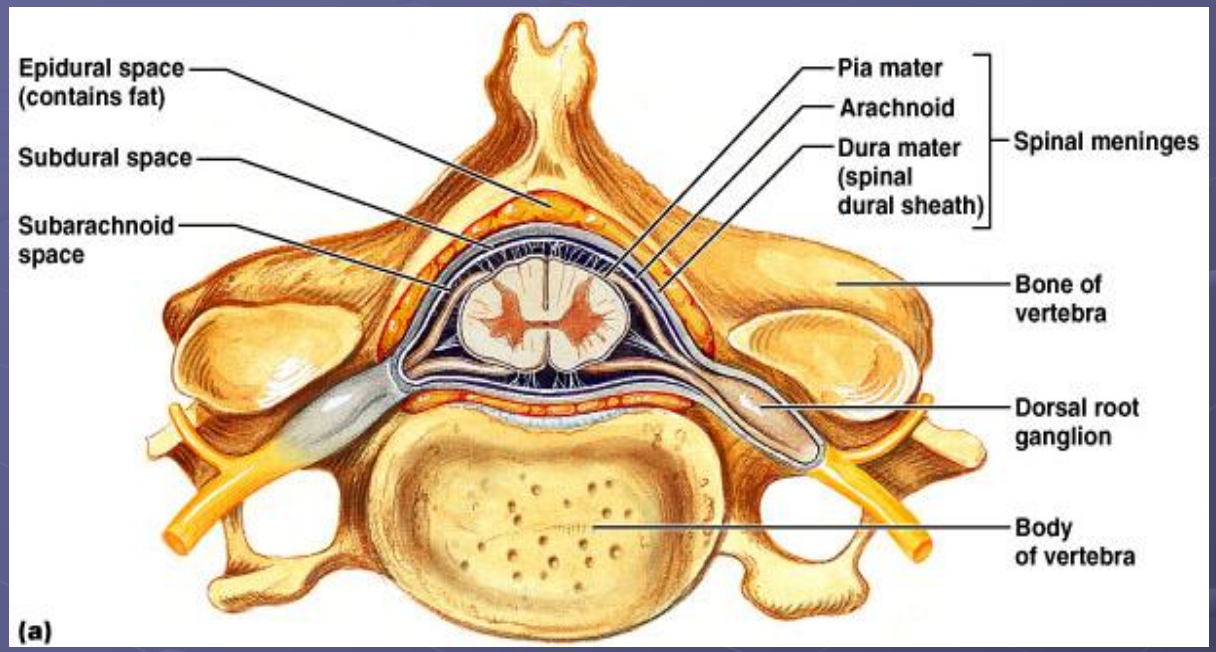


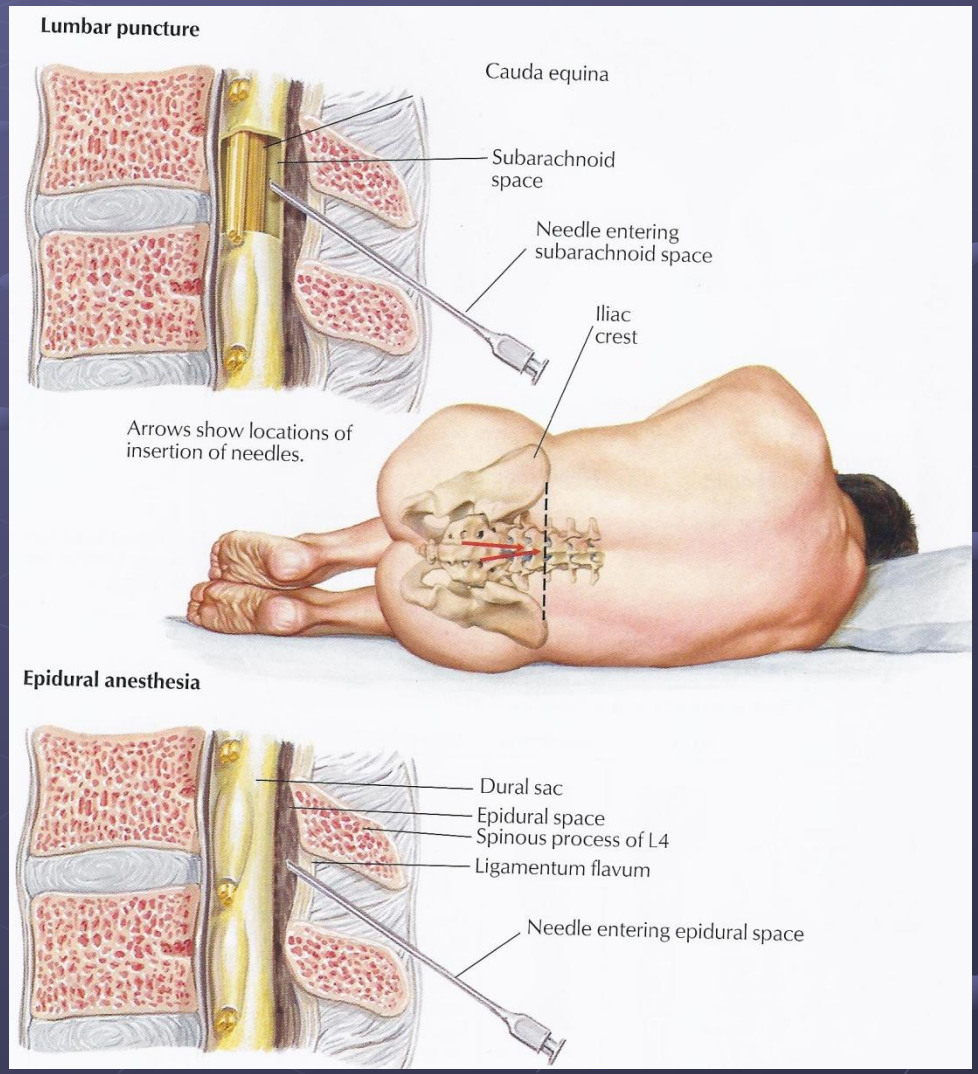
Fig 13.30

Compare the spinal roots with the model of the vertebral column in the lab. Note that the dura covers both the dorsal and ventral roots.

Lumbar Puncture vs. Epidural

- Lumbar puncture:
  - Penetrates the dura, into the subarachoid space
  - Sample CSF
  - Spinal anesthetic
- Epidural
  - “Upon the dura”
  - Anesthesia

Usually at L4-L5



Organization of Spinal Cord

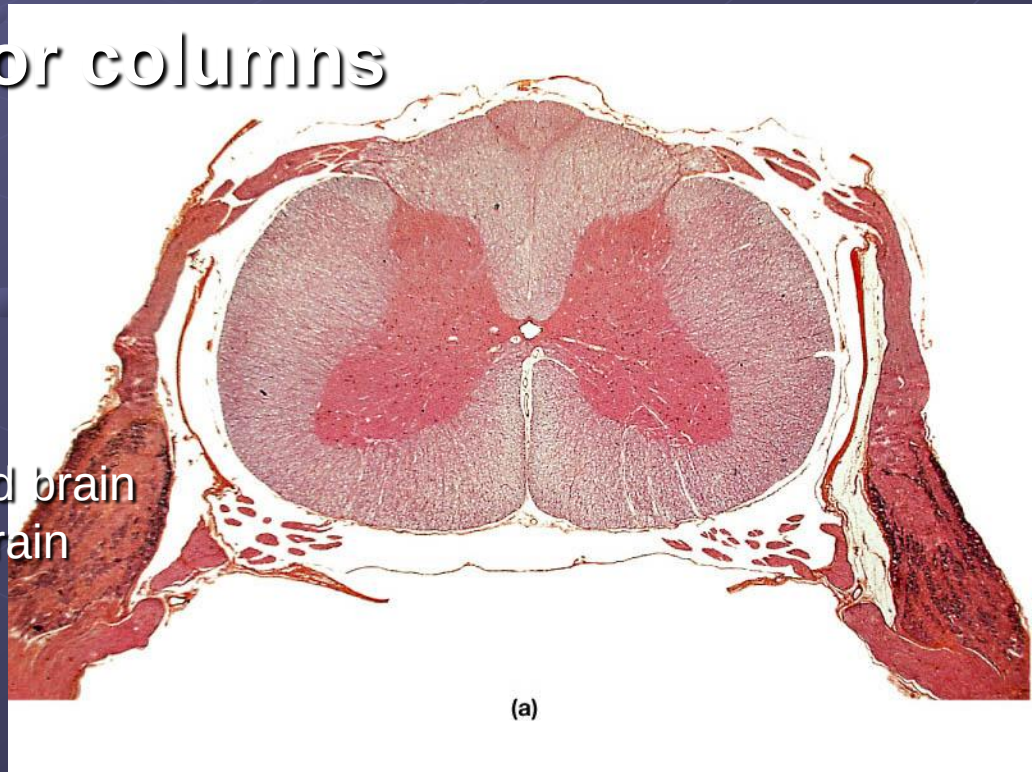
Gray matter - interior horns

posterior - somatic and visceral sensory nuclei
anterior (and lateral) gray horns – somatic and visceral motor control
gray commissures - axons carrying information from side to side

White matter - tracts or columns

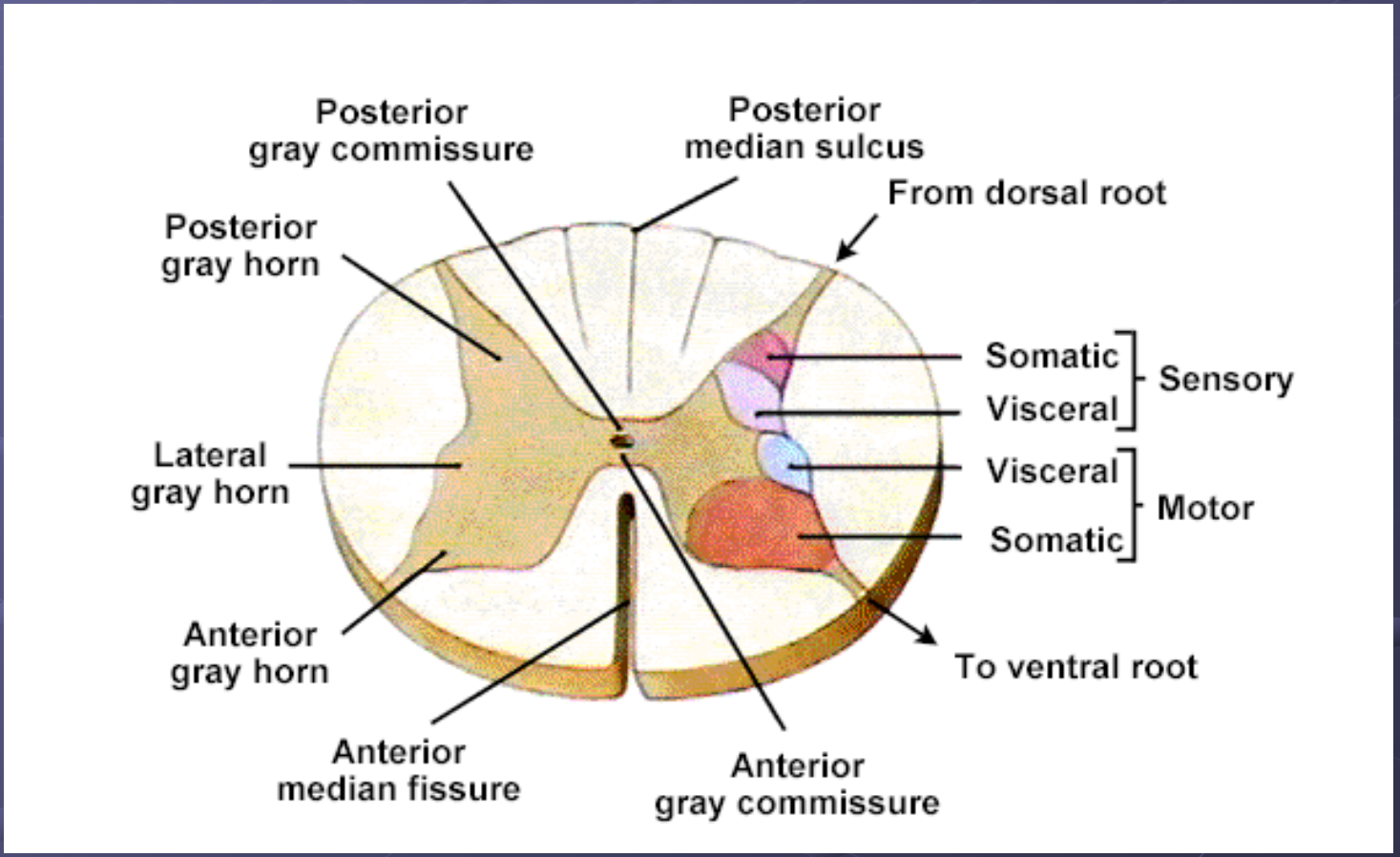
posterior white column -
anterior white column
lateral white column
anterior white commissure

functions
ascending tracts - sensory toward brain
descending tracts - motor from brain



Sectional anatomy of spinal cord

Outer white part; inner gray butterfly



Organization of Spinal Nerves

1. **Root – inside vertebral canal**
   - **a. dorsal sensory root with a ganglion**
   - **b. ventral motor root**

2. **Mixed spinal nerve**

3. **Rami**
   - **a. dorsal - mixed to skin and muscles of back**
   - **b. ventral - mixed "spinal nerve" to ventrolateral body surfaces and limbs**
   - *c. white ramus communicans motor ANS*
   - *d. gray ramus communicans motor ANS*

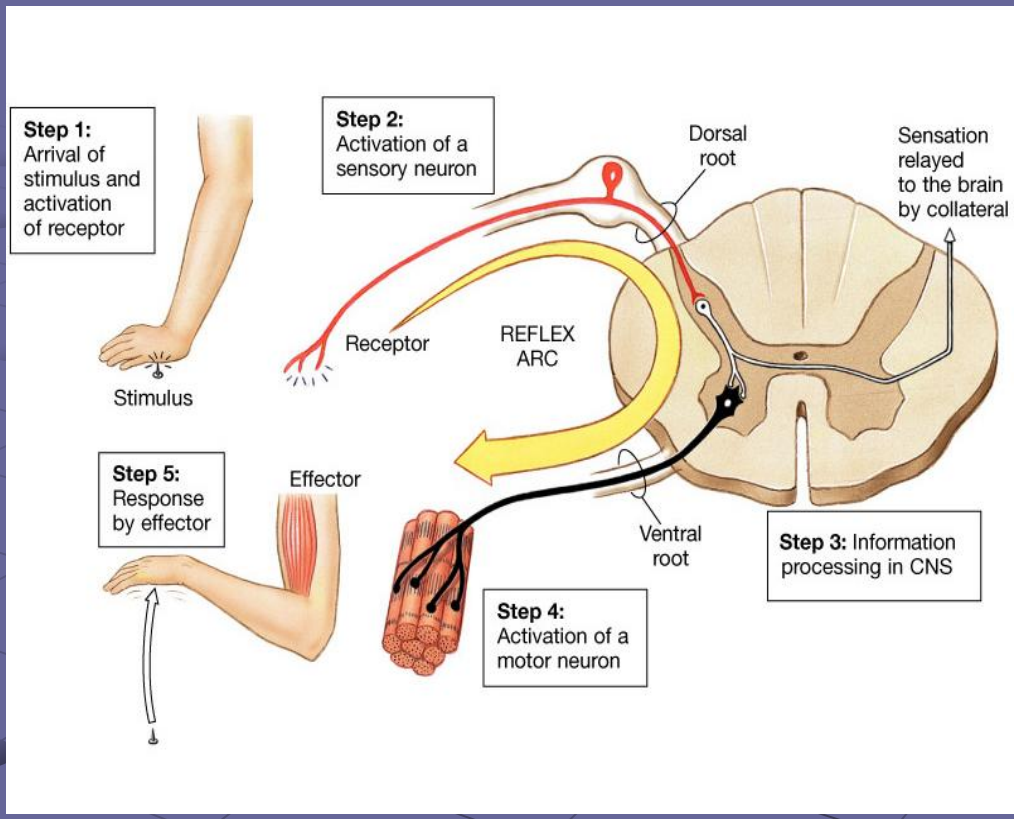
Reflexes

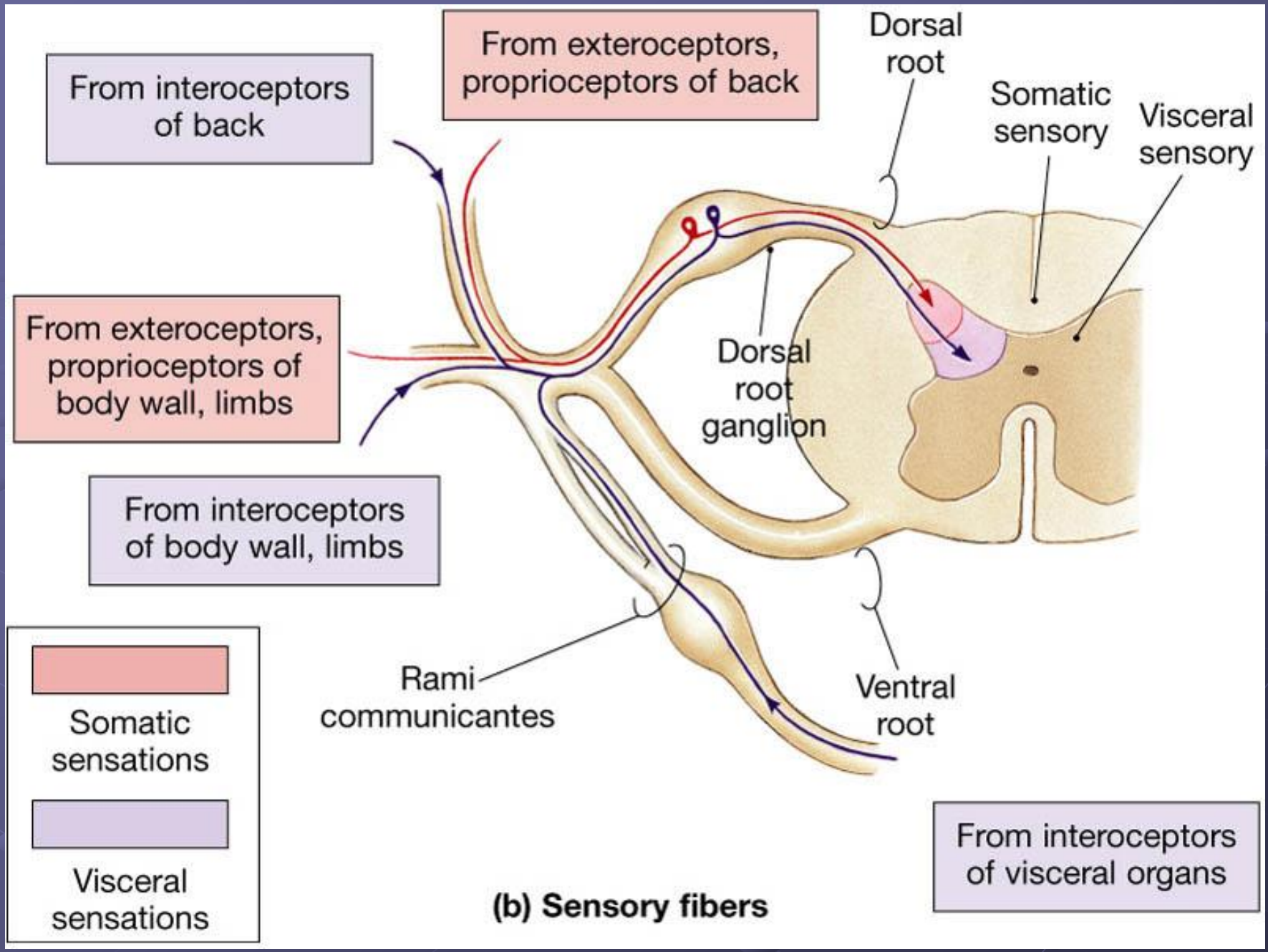
Fast, preprogrammed, inborn, automatic responses

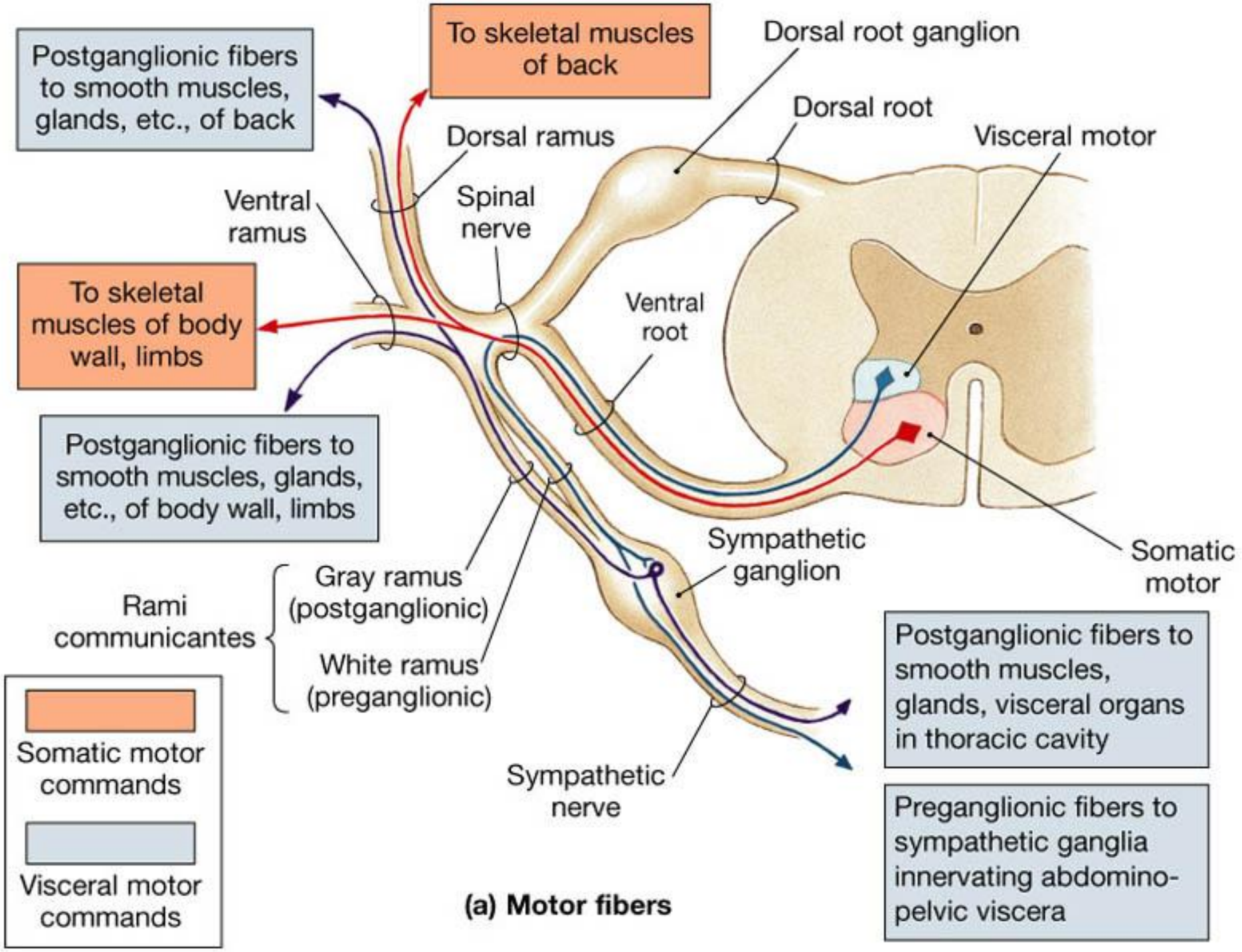
Occur in the CNS at the spinal cord or brainstem levels (cranial nerves)

May be either monosynaptic or polysynaptic

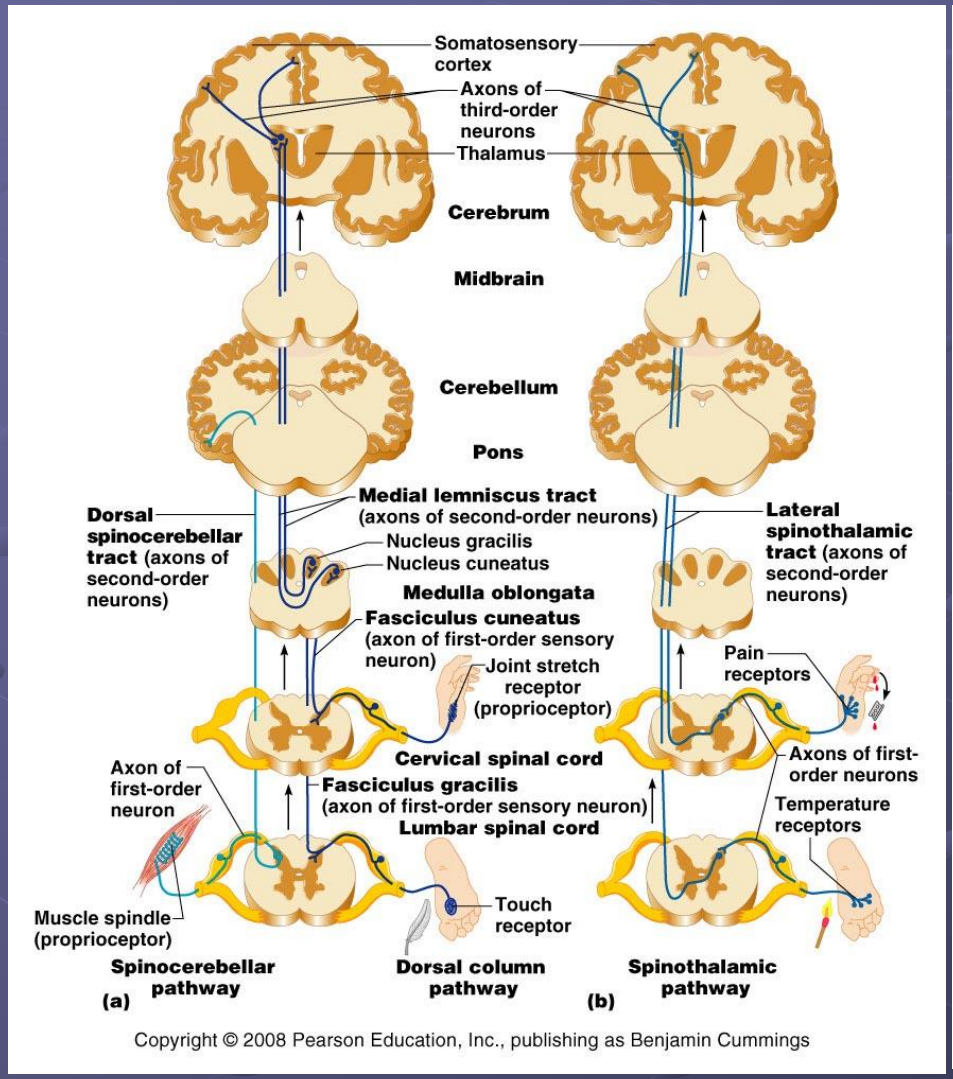
All require
- a. stimulus at receptor
- b. sensory information relay
- c. processing at CNS level
- d. activation of motor response
- e. response of peripheral effector


Step 1: Arrival of stimulus and activation of receptor
Stimulus
Step 2: Activation of a sensory neuron
Receptor
REFLEX ARC
Dorsal root
Sensation relayed to the brain by collateral
Step 3: Information processing in CNS
Ventral root
Step 4: Activation of a motor neuron
Effector
Step 5: Response by effector


From interoceptors of back
From exteroceptors, proprioceptors of back
Dorsal root
Somatic sensory
Visceral sensory
From exteroceptors, proprioceptors of body wall, limbs
Dorsal root ganglion
From interoceptors of body wall, limbs
Somatic sensations
Visceral sensations
Rami communicantes
Ventral root
From interoceptors of visceral organs
(b) Sensory fibers


Postganglionic fibers to smooth muscles, glands, etc., of back
To skeletal muscles of back
Dorsal root ganglion
Dorsal root
Dorsal ramus
Visceral motor
Ventral ramus
Spinal nerve
To skeletal muscles of body wall, limbs
Ventral root
Postganglionic fibers to smooth muscles, glands, etc., of body wall, limbs
Sympathetic ganglion
Somatic motor
Rami communicantes
Gray ramus (postganglionic)
White ramus (preganglionic)
Postganglionic fibers to smooth muscles, glands, visceral organs in thoracic cavity
Somatic motor commands
Visceral motor commands
Sympathetic nerve
Preganglionic fibers to sympathetic ganglia innervating abdomino-pelvic viscera
(a) Motor fibers

Ascending and Descending Tracts



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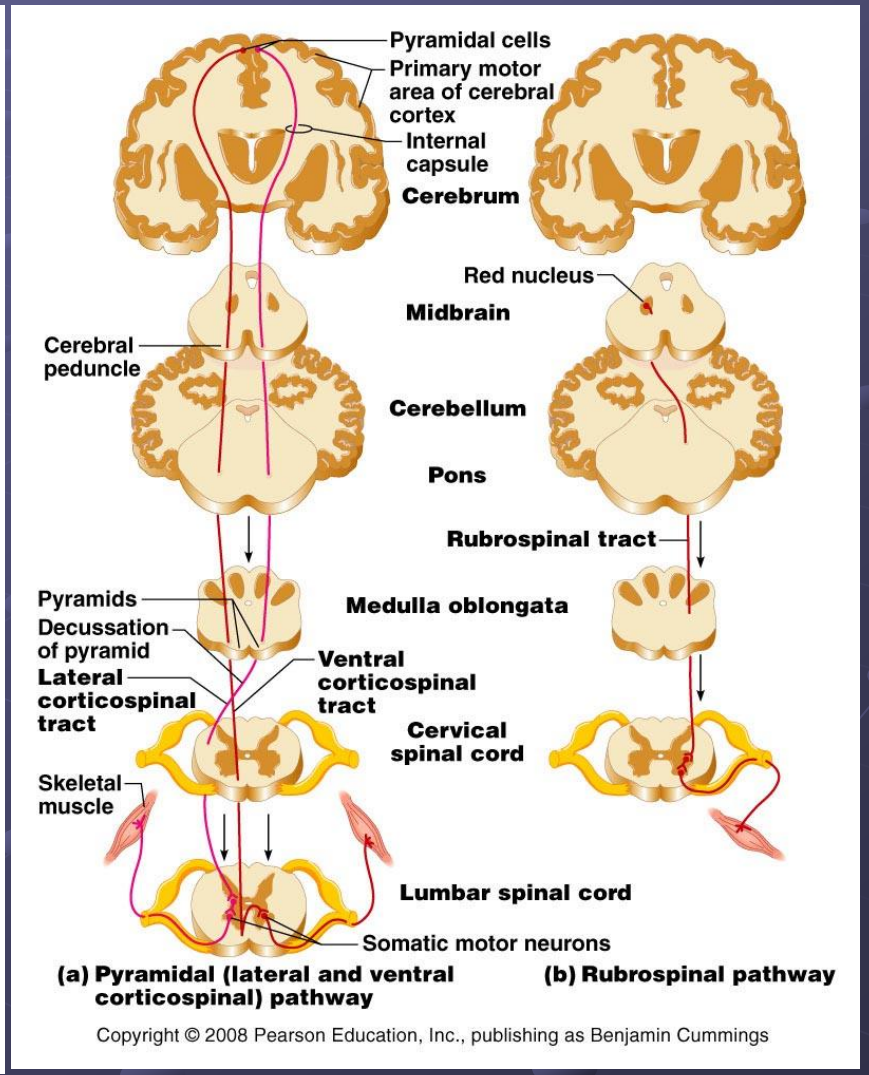

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Dermatomes

- **Sensory innervations by specific spinal nerves ⇒ Each pair of spinal nerves monitors specific region of body surface.**